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ENTRY SYSTEMS BACKGROUND

- **HYPERSONIC VEHICLES STUDIES**

- Aerothermal / Structural Concepts AFWAL 1985-1987

- **AEROBRAKING SPACE TRANSFER VEHICLES (ASTV) STUDIES**

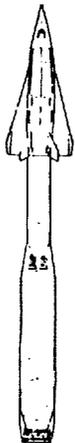
- Concepts Definition studies/ Turnaround Operations/ Space Navigation and Aerobraking/ Centaur- derived Lunar Transfer Vehicles NASA centers 1979-1990

- ASTV-related IR&D Studies involving wind- tunnel testing, aerothermodynamics, GN&C and STV design studies 1983-1991

AEROTHERMAL / STRUCTURAL CONCEPTS STUDY

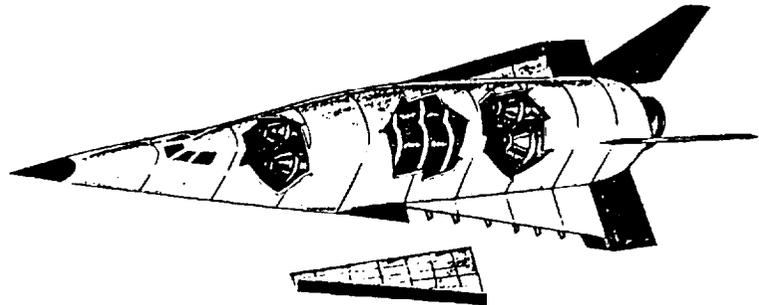
OBJECTIVES

- Establish aerothermal environments for hypersonic aerospace vehicles.
- Develop thermostructural design concepts.
- Obtain optimum Thermostructural designs by performing trade studies
- Identify areas for further development



Length	95 ft
Height	26 ft 8 in.
Wing span	37 ft 6 in.
Takeoff weight	98,000 lb
Payload	5,000 lb
Empty	43,000 lb
Propellants	48,400 lb
LO ₂	41,500 lb
LH ₂	6,900 lb

Suborbital vehicle
and booster



TPS TECHNOLOGY REQUIREMENTS

- ADVANCED RADIATORS, INSULATORS AND ABLATORS
 - COATED REFRACTORY METALS
 - RIGID CERAMICS
 - FLEXIBLE CERAMICS
 - ADVANCED CARBON CARBON

- ACTIVE COOLING DEVICES FOR HOT STRUCTURES

PROGRAM ENABLING TECHNOLOGY ASSESSMENT

Program Area: Hypersonics

Technology Area: Aerothermodynamics

Priority Requirement (Source)	Government Technology Development	Industry Technology Development
Enabling Technology		
Aerodynamic Heating	<u>Current</u>	<u>Current</u>
Enabling Technology Real gas effects Boundary layer transition Turbulence modeling Shock boundary layer interaction Shock impingement Rarefied flows Chemical non-equilibrium Thermal non-equilibrium Surface catalysis/surface reflectance	<ul style="list-style-type: none"> • SEI Studies • NASP related studies • HYFLEX 	
	<u>Needed</u>	<u>Needed</u>
Thermal Control	<u>Current</u>	<u>Current</u>
Enabling Technology High temperature heat pipes Nose-tip and Leading edge cooling/ temperature control Active cooling Antenna cooling Electronics cooling Insulation Ablation		
	<u>Needed</u>	<u>Needed</u>

PROGRAM ENABLING TECHNOLOGY ASSESSMENT

Program Area: Hypersonics

Technology Area: High Temperature Structures and TPS

Priority Requirement (Source) Enabling Technology	Government Technology Development	Industry Technology Development
Affordable, Reliable Hot Structures	<u>Current</u>	<u>Current</u>
Enabling Technology High temperature materials Hybrid design Joints, seals and adhesives Nose and leading edge Fasteners	<u>Needed</u>	<u>Needed</u>
High Temperature TPS	<u>Current</u>	<u>Current</u>
Enabling Technology Carbon/carbon insulation High temperature flexible TPS High temperature rigid TPS Active cooling Ablators	<u>Needed</u>	<u>Needed</u>